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## FIRST RECORD OF *MYOTIS NESOPOLUS* FROM COLOMBIA

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### ABSTRACT

Herein we report the first Colombian record of the insectivorous bat *Myotis nesopolus*, collected in a dry forest of Albania, Cerrejón, Department of La Guajira, in the Colombian Caribbean region. To confirm our taxonomic identification, we assessed the morphological and morphometric variation of representatives of *M. nigricans*, the only other species in the genus reported from the Colombian Caribbean region, through an analysis of variance (ANOVA) and a principal components analysis (PCA). Material used is deposited at the Instituto de Ciencias Naturales of the Universidad Nacional de Colombia. Our analyses revealed that our *Myotis* specimen from Albania fell into the morphometric range described for *M. nesopolus* and statistically significant differences were found when it was compared with *M. nigricans* specimens from the region. Taxonomic remarks of the analyzed species are included.

Key words: Caribbean, Colombia, La Guajira, *Myotis nesopolus*

### RESUMEN

Presentamos el primer registro colombiano de la especie de murciélago insectívoro *Myotis nesopolus* colectado en un bosque seco de Albania, Cerrejón, departamento de La Guajira. Con el fin de confirmar nuestra identificación taxonómica, evaluamos la variación morfológica y morfométrica de representantes *M. nigricans*, la única otra especie reportada para el Caribe colombiano mediante un análisis de varianza (ANOVA) y un análisis de componentes principales (PCA). El material utilizado en el análisis se haya depositado en la colección del Instituto de Ciencias Naturales de la Universidad Nacional de Colombia (ICN). Nuestros análisis revelaron que el ejemplar de Albania está dentro de los rangos propuestos para *M. nesopolus* y diferencias significativas se encontraron cuando se le comparó con especímenes de *M. nigricans* del Caribe colombiano. Comentarios taxonómicos de las especies analizadas son incluidos.

Palabras clave: Caribe, Colombia, La Guajira, *Myotis nesopolus*

## INTRODUCTION

The genus *Myotis* Kaup 1829 (Chiroptera: Vespertilionidae) comprises a diverse group of species that are distributed worldwide (Simmons 2005). In Colombia, the genus *Myotis* currently is represented by six species (*M. albescens*, *M. keaysi*, *M. nigricans*, *M. oxyotus*, *M. riparius*, and *M. simus*) distinguishable from each other by a set of external and cranial characters (Appendix I), and all of them are characterized by wide geographic distributions (Alberico et al. 2000). However, only *M. nigricans* has been documented for the Colombian Caribbean (Hershkovitz 1949). Within the genus, *M. nesopolus* has the most restricted continental distribution among species found in South America (LaVal 1973; Handley 1976). *Myotis nesopolus* originally was described by Miller (1900), based on an adult male specimen collected by Mr. L. B.

Smith in an attic of his store in Pimda (spelled Punda on the USNM collections website and in Genoways and Williams [1979]), near Willemstad, Island of Curaçao, 500 masl, on 4 November 1899. The holotype of *M. nesopolus* is deposited at the United States National Museum of Natural History of the Smithsonian Institution (catalogue number USNM 101849), preserved as skin and skull (originally in formalin). The species also has been recorded from Bonaire and Venezuela (LaVal 1973; Handley 1976; Simmons 2005; Larsen et al. 2012; Fig. 1). Although Alberico et al. (2000) suggest the presence of *M. nesopolus* in Colombian territory based on its presence in adjacent localities in Venezuela (records in Handley [1976]), to date there are no documented voucher specimens supporting this hypothesis. Muñoz-Arango (2001) proposed that the

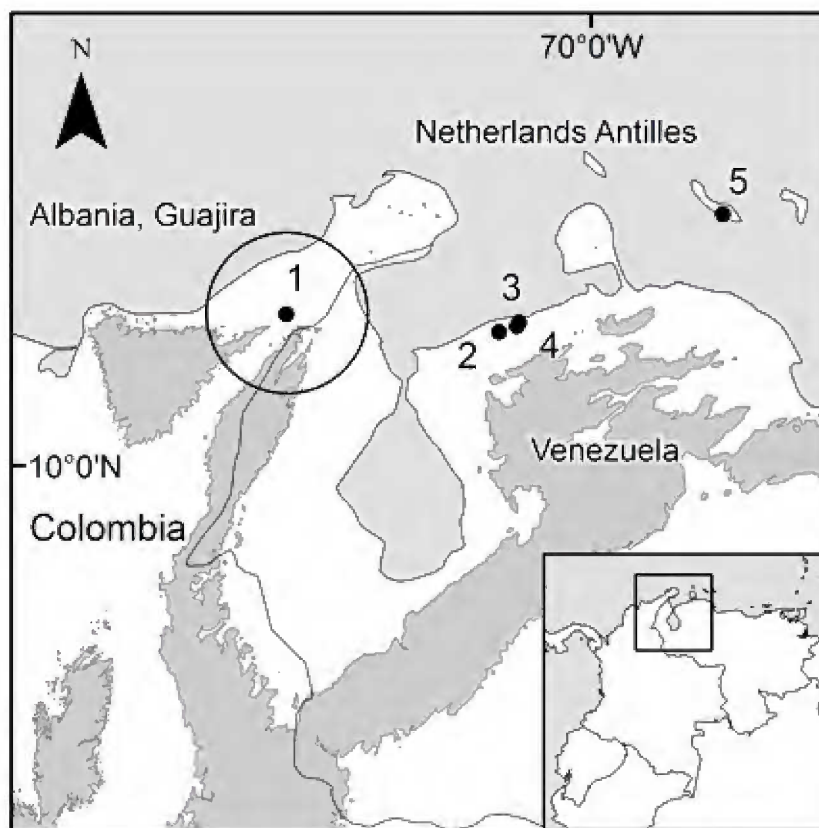


Figure 1. 1) First confirmed Colombian record of *M. n. larensis* from Albania, Guajira (11°09'35.01"N, 72°35'06.09"W); 2) Collecting locality of *M. n. larensis* at Capatarida, Venezuela; 3 and 4) Collecting localities of *M. n. larensis* at Falcon, Venezuela; and 5) Type locality of *Myotis nesopolus nesopolus* in Willemstad, Curaçao (Miller 1900).

species is distributed across arid environments in the Colombian Caribbean based on Eisenberg (1989) and made reference of *M. nesopolus* material from Maicao and Santa Marta, in the departments of La Guajira and Magdalena. These records were thought to be included in Hershkovitz (1949), but have been disputed by Gardner (2007).

We revisited Hershkovitz (1949) and found no reference of *M. nesopolus*. The only species of *Myotis* reported for the Colombian Caribbean region by this author is *M. nigricans nigricans* from various localities in the departments of Bolivar, Cesar, and Magdalena. The presence of this species in Colombia also was suggested by LaVal (1973) and Cuervo-Diaz et al. (1986; comment accompanied by a question mark, p. 482). To date, *M. nigricans* is the only species confirmed in the Colombian Caribbean region by voucher specimens

(Wilson 2008). In a recent revision of material of the genus *Myotis* from the Colombian Caribbean, we found a specimen (ICN 19174) matching all discrete characters and within morphometric ranges of *M. nesopolus* collected in Albania, on the piedmonts of Cuchilla el Chorro; a locality which is part of the semiarid environments of the central lowlands of La Guajira peninsula, characterized by sand dunes and a warm and arid climate in the Caldas Lang Climate Classification System (Instituto Agustín Codazzi 2008). In order to verify the taxonomic status of the putative record of *M. nesopolus* from La Guajira, we assessed the morphological and morphometric variation of representatives of the genus *Myotis* from the Colombian Caribbean deposited at the mammal collection of the Instituto de Ciencias Naturales of the Universidad Nacional de Colombia, as well as the holotype of *M. n. larensis* deposited at the American Museum of Natural History (AMNH).

## METHODS

*Morphological analysis.*—Morphological diagnostic characters in the original *M. nesopolus* description (Miller 1900), as well as in the description of the currently recognized race *M. n. larensis* (LaVal 1973), were evaluated for each analyzed specimen.

*Morphometric analyses.*—To assess the morphometric variation of analyzed *Myotis* specimens, a Principal Components Analysis (PCA) and an Analysis of Variance (ANOVA) were conducted on 18 craniodental

(Appendix II) measurements from 16 specimens (Appendix III). These included the putative *M. nesopolus* (ICN 19174) from La Guajira and 15 *M. nigricans* from the Colombian Caribbean departments of Bolivar (n=8) and Córdoba (n=7; Table 1; Appendix III). In addition, external measurements (forearm, FA; third metacarpal, 3<sup>rd</sup> Met; and tibia, T) and ratios between cranial and appendicular measurements (as proposed in LaVal [1973]) were recorded to distinguish between *M. nesopolus* and *M. nigricans* (Table 2).

## RESULTS AND DISCUSSION

We introduce the first confirmed record of *M. nesopolus* from the Colombian territory, represented by a male specimen preserved as skin and skull in good condition and deposited at the Instituto de Ciencias Naturales of the Universidad Nacional de Colombia (ICN) with catalogue number ICN 19174. The specimen was collected by L. M. Bejarano, M. Herrera, and D. González on 20 December 2005; collectors number LMB 4623 (Figs. 2, 3), at Albania, Cerrejón Río Ranchería, Los Pozos, Department of La Guajira (11°09'35.01"N, 72°35'06.09"W) at 86 masl (Fig. 1). Specimen ICN 19174 from Albania matches all the

diagnostic characters in the original description of *M. nesopolus* (Miller 1900, p. 123): “Similar to *M. nigricans* Wied from Colombia but paler in color and slightly smaller; dorsal surface intermediate between raw umber and Proust’s brown in Ridgway (1912) (Nomenclature numbers Plate III, 11 and 14) the basis of the hairs just perceptibly darker. Ventral surface ochraceous buff with the basal half of the hairs slaty black” (Fig. 2). In the description of *M. nesopolus*, Miller (1900) mentioned that the skull in this taxon resembles that of *M. nigricans* from Santa Marta, in the Colombian Caribbean region. We found no significant differences

Table 1. Eighteen cranio-dental measurements (described in Appendix II) of *M. nesopolus* specimen ICN 19174 from La Guajira and 15 *M. nigricans* specimens from the Colombian Caribbean departments of Bolivar ( $n=9$ ) and Córdoba ( $n=6$ ).

| ICN                 | Sex    | GLS   | CIL   | CCL   | CBL  | PAL   | TR   | TR-I | M-M  | AOC  | MB   | BCB  | ZB   | POC  | C-C  | MH   | ITR  | LM    |
|---------------------|--------|-------|-------|-------|------|-------|------|------|------|------|------|------|------|------|------|------|------|-------|
| <i>M. nesopolus</i> |        |       |       |       |      |       |      |      |      |      |      |      |      |      |      |      |      |       |
| 19174               | Male   | 13.89 | 12.93 | 12.28 | 5.12 | 10.38 | 5.75 | 6.39 | 5.41 | 5.37 | 3.76 | 6.98 | 6.62 | 8.01 | 3.43 | 3.34 | 3.62 | 10.35 |
| <i>M. nigricans</i> |        |       |       |       |      |       |      |      |      |      |      |      |      |      |      |      |      |       |
| 16040               | Male   | 13.56 | 12.38 | 11.64 | 4.61 | 9.77  | 5.77 | 6    | 5.02 | 5.11 | 3.61 | 6.62 | 6.48 | 8.07 | 3.46 | 3.35 | 2.97 | 9.78  |
| 16043               | Male   | 13.39 | 12.5  | 11.53 | 4.67 | 9.68  | 5.71 | 5.96 | 4.87 | 4.64 | 3.38 | 6.72 | 6.07 | 8.08 | 3.42 | 3.38 | 2.96 | 9.65  |
| 16044               | Male   | 13.53 | 12.41 | 11.42 | 4.87 | 9.57  | 5.55 | 6.01 | 5.03 | 4.09 | 3.45 | 6.71 | 6.43 | 8.19 | 3.37 | 3.48 | 2.84 | 9.55  |
| 16046               | Male   | 13.5  | 12.27 | 11.34 | 4.67 | 9.5   | 5.47 | 5.84 | 5    | 4.84 | 3.33 | 6.25 | 6.44 | 7.92 | 3.29 | 3.36 | 2.92 | 9.29  |
| 16047               | Male   | 13.11 | 12.12 | 11.23 | 4.51 | 9.29  | 5.36 | 5.79 | 4.85 | 4.84 | 3.26 | 6.52 | 6.17 | 7.74 | 3.34 | 3.25 | 2.77 | 9.29  |
| 16048               | Male   | 13.42 | 12.49 | 11.43 | 4.85 | 9.8   | 5.31 | 6.12 | 4.92 | 5.18 | 3.37 | 6.74 | 6.39 | 8.11 | 3.33 | 3.37 | 2.86 | 9.58  |
| 17327               | Male   | 13.23 | 12.02 | 11.09 | 4.71 | 9.4   | 5.23 | 5.7  | 4.7  | 4.86 | 3.44 | 6.49 | 6.33 | 7.69 | 3.22 | 3.3  | 2.92 | 9.45  |
| Mean                |        | 13.39 | 12.31 | 11.38 | 4.7  | 9.57  | 5.49 | 5.92 | 4.91 | 4.79 | 3.41 | 6.58 | 6.33 | 7.97 | 3.35 | 3.36 | 2.89 | 9.51  |
| StDev               |        | 0.17  | 0.18  | 0.18  | 0.13 | 0.19  | 0.2  | 0.15 | 0.12 | 0.36 | 0.11 | 0.18 | 0.15 | 0.19 | 0.08 | 0.07 | 0.07 | 0.18  |
| 16041               | Female | 13.36 | 12.26 | 11.53 | 4.59 | 9.94  | 5.43 | 5.9  | 4.96 | 4.89 | 3.46 | 6.55 | 6.33 | 8.07 | 3.42 | 3.3  | 3.08 | 9.55  |
| 16042               | Female | 13.57 | 12.55 | 11.44 | 4.9  | 10.11 | 5.45 | 6.14 | 5.05 | 4.75 | 3.51 | 6.85 | 6.35 | 8.05 | 3.48 | 3.42 | 3.08 | 9.77  |
| 17326               | Female | 13.46 | 12.48 | 11.57 | 4.69 | 10.64 | 5.62 | 5.99 | 4.94 | 5.05 | 3.36 | 6.78 | 6.52 | 7.77 | 3.35 | 3.36 | 2.75 | 9.81  |
| 17328               | Female | 13.68 | 12.95 | 11.85 | 4.72 | 9.97  | 5.73 | 5.96 | 4.97 | 4.87 | 3.34 | 6.86 | 6.58 | 7.84 | 3.2  | 3.52 | 2.72 | 9.91  |
| 17329               | Female | 13.43 | 12.27 | 11.24 | 4.54 | 9.7   | 5.32 | 5.82 | 4.73 | 4.72 | 3.26 | 6.49 | 6.18 | 7.6  | 3.28 | 3.31 | 2.76 | 9.68  |
| 17330               | Female | 12.99 | 12.06 | 11.17 | 4.82 | 9.69  | 5.97 | 5.79 | 4.8  | 4.66 | 3.99 | 6.44 | 6.24 | 7.75 | 3.23 | 3.18 | 2.96 | 9.25  |
| 17331               | Female | 13.36 | 12.09 | 11.08 | 4.57 | 9.7   | 5.2  | 5.82 | 4.84 | 4.4  | 3.13 | 6.62 | 6.3  | 7.56 | 3.47 | 3.32 | 2.61 | 9.62  |
| Mean                |        | 13.41 | 12.38 | 11.41 | 4.69 | 9.96  | 5.53 | 5.92 | 4.9  | 4.76 | 3.44 | 6.66 | 6.36 | 7.81 | 3.35 | 3.34 | 2.85 | 9.66  |
| StDev               |        | 0.22  | 0.31  | 0.27  | 0.13 | 0.34  | 0.26 | 0.12 | 0.11 | 0.21 | 0.27 | 0.17 | 0.14 | 0.2  | 0.11 | 0.11 | 0.19 | 0.22  |
| 17337               | Undet. | 14.33 | 13.09 | 12.11 | 5.09 | 10.43 | 5.73 | 6.29 | 5.15 | 5.45 | 3.93 | 7.4  | 7.27 | 8.23 | 4.07 | 3.36 | 3.56 | 10.56 |

Table 2. Ratios between third metacarpal (3<sup>rd</sup> Met), tibia (TB), greatest skull length (GSL), and forearm (FA) of analyzed *Myotis* specimens from the Colombian Caribbean. These characters are proposed by Laval (1973) as useful to discriminate *M. nesopolus* *larensis* from *M. nigricans*. Asterisks represent the largest values obtained.

| Species                                     | ICN   | Ratio 3rd Met | Ratio TB/FA | Ratio GSL/FA |
|---------------------------------------------|-------|---------------|-------------|--------------|
| <i>M. nesopolus</i> Guajira, Colombia       | 19174 | 0.98*         | 0.45*       | 0.43*        |
| <i>M. n. larensis</i> holotype (LaVal 1973) |       | 0.96          | 0.48        | 0.43         |
| <i>M. nigricans</i>                         | 16040 | 0.90          | 0.41        | 0.42         |
| <i>M. nigricans</i>                         | 16041 | 0.88          | 0.41        | 0.40         |
| <i>M. nigricans</i>                         | 16042 | 0.93          | 0.39        | 0.39         |
| <i>M. nigricans</i>                         | 16043 | 0.89          | 0.39        | 0.41         |
| <i>M. nigricans</i>                         | 16044 | 0.94          | 0.39        | 0.41         |
| <i>M. nigricans</i>                         | 16045 | 0.95          | 0.41        | 0.42         |
| <i>M. nigricans</i>                         | 16046 | 0.92          | 0.43        | 0.42         |
| <i>M. nigricans</i>                         | 16047 | 0.91          | 0.40        | 0.42         |
| <i>M. nigricans</i>                         | 16048 | 0.96          | 0.42        | 0.42         |
| <i>M. nigricans</i>                         | 17326 | 0.89          | 0.43        | 0.39         |
| <i>M. nigricans</i>                         | 17327 | 0.97          | 0.42        | 0.41         |
| <i>M. nigricans</i>                         | 17328 | 0.92          | 0.42        | 0.39         |
| <i>M. nigricans</i>                         | 17329 | 0.89          | 0.38        | 0.39         |
| <i>M. nigricans</i>                         | 17330 | 0.92          | 0.36        | 0.39         |
| <i>M. nigricans</i>                         | 17331 | 0.92          | 0.44        | 0.40         |

(ANOVA,  $F=0.06888$ ;  $P>0.05$ ) among 18 cranial measurements (Fig. 4, Table 1) obtained from our specimen of *M. nesopolus* (ICN 19174) from La Guajira and 15 *M. nigricans* specimens from the Colombian Caribbean departments of Bolivar ( $n=8$ ) and Córdoba ( $n=7$ ; Appendix III). In our (PCA) morphospace, the *M. nesopolus* specimen ICN 19174 clustered with the largest *M. nigricans* specimen analyzed (ICN 17337 from Córdoba; Fig. 4).

Since Miller and Allen (1928) considered *M. nesopolus* as a subspecies of *M. nigricans*, this taxon was not included in the revision of the genus made by

LaVal (1973). However, in the same work the author proposed that continental populations of *Myotis* from northwestern Venezuela (provinces of Lara, Zulia, Maracaibo, Falcon, and Capatariida) represent the distinct form *M. larensis*.

Average measurements presented by Genoways and Williams (1979) suggest a larger size of *M. larensis* when compared with *M. nesopolus* from the Caribbean. However, a Stepwise Discriminant Canonical Analysis performed by these authors, including representatives of *M. larensis* from northwestern Venezuela ( $n=33$ ), typical *M. nesopolus* from the Islands of Bonaire and





Figure 2. Ventral view of the skin of *Myotis nesopolus* male specimen ICN 19174, from La Guajira, Colombia (left), and *M. nigricans* ICN 16040 from Bolivar, Colombia (right).

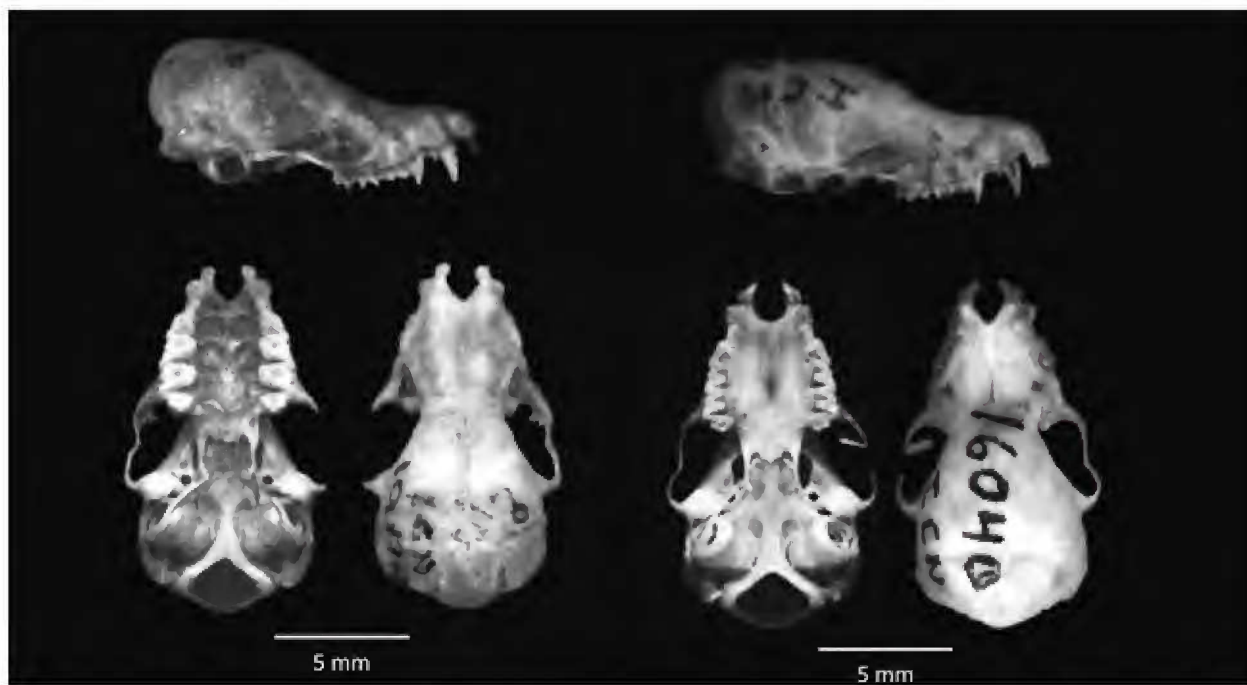


Figure 3. Lateral, ventral, and dorsal views of skulls of male specimens of *Myotis nesopolus* ICN 19174 (left), from La Guajira, Colombia, and *M. nigricans* ICN 16040 (right), from Bolivar, Colombia.

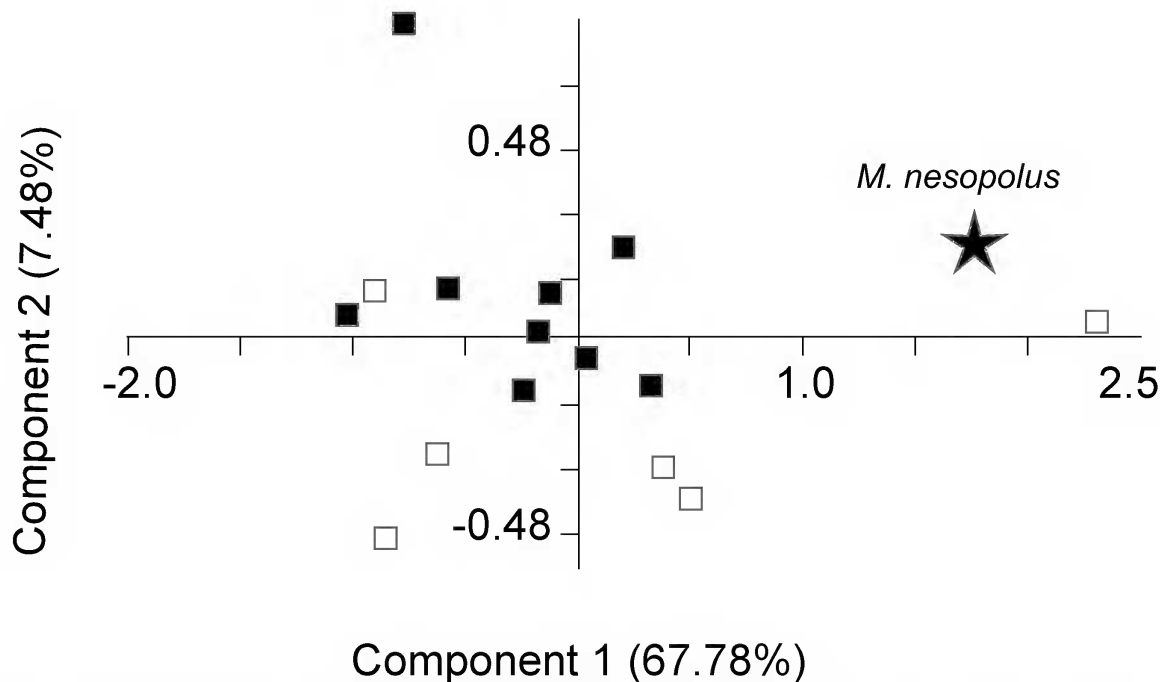


Figure 4. Principal Components Analysis (PCA) performed on 18 craniodental measurements of *M. nesopolus* (black star) and 15 *M. nigricans* from the Colombian departments of Bolivar (black squares) and Córdoba (white squares).

Curaçao ( $n=12$ ), as well as continental representatives of *M. albescens*, *M. keaysi*, and *M. nigricans*, resulted in no discrimination between *M. nesopolus* populations from the Caribbean and *M. laevis* from the mainland. Based on these findings, Genoways and Williams (1979) synonymized *Myotis* populations from northern Venezuela with *M. nesopolus* from the Caribbean.

In a recent analysis of the nuclear and mitochondrial DNA sequence variation among *Myotis* populations from northern South America and the Lesser Antilles, Larsen et al. (2012) concluded that specimens from Venezuela had a close relationship with typical *M. n. nesopolus* from Bonaire. However, observed genetic distances (4.1%) between island and continental populations of *M. nesopolus* were larger than those typically expected among mammal subspecies (based on Bradley and Baker [2001]). Larsen et al. (2012) proposed that

morphologically and genetically analyzed specimens from Venezuela may correspond to the traditionally recognized subspecies *M. n. laevis*, sensu LaVal (1973) and Genoways and Williams (1979), and suggest a further taxonomic assessment of *M. n. laevis* populations to determine its taxonomic status.

Besides the geographic proximity to previously identified specimens of *M. n. laevis* in Venezuela (Handley 1976; Fig. 1), the Colombian specimen ICN 19174 from La Guajira also shares the proposed diagnostic characters for *M. n. laevis*: third metacarpal, tibia, and skull longer in relation to the forearm (ratios presented in Table 2). We conclude that our specimen ICN 19174 represents the subspecies *M. n. laevis* and may be part of the divergent clade identified by Larsen et al. (2012), pending further genetic and morphologic analyses.

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## APPENDIX I

Diagnostic characters identifying Colombian species of *Myotis*.

| Species             | Hairy Uropatagium | Sagittal Crest | Hair length (mm) | Dorsal Coat Color | Ventral Coat Color | FA (mm) | Geographic affinity Elevation (masl) |
|---------------------|-------------------|----------------|------------------|-------------------|--------------------|---------|--------------------------------------|
| <i>M. albescens</i> | No                | No             | 4.0 – 5.0        | Frosted tips      | White              | >36     | All regions                          |
| <i>M. keaysi</i>    | Yes               | Present        | 4.0 – 6.0        | Brownish          | Ochreaceous        | >42     | (>1200)                              |
| <i>M. nigricans</i> | No                | No             | 5.0 – 7.0        | Dark              | Pale brown         | <39     | All regions                          |
| <i>M. oxyotus</i>   | No                | Present        | 6.0 – 7.0        | Dark brown        | Ochreaceous        | >42     | (>1500)                              |
| <i>M. riparius</i>  | No                | Present        | 4.0 – 6.0        | Pale brown        | Cream              | >36     | All regions                          |
| <i>M. simus</i>     | No                | Present        | < 2.0            | Orange            | Orange             | >36     | Amazon basin                         |
| <i>M. nesopolus</i> | No                | No             | 5.0 – 6.0        | Pale brown        | Cream              | <34     | Arid Env. Caribbean                  |

## APPENDIX II

Description of acronyms used for measurements: Greatest length of skull (GLS); condyloincisive length (CIL); condylocanine length (CCL); skull height (SH); basicranial length (BCL); palatal length (PAL); tooth-row length (TR); tooth-row length without incisive (TR-I); distance across upper molars (M-M); anteorbital constriction width (AOC); mastoid breadth (MB); braincase breadth (BCB); zygomatic breadth (ZB); postorbital constriction (POC); distance across upper canines (C-C); mandible height (MH); mandibular tooth-row (ITR); mandible length (ML).

## APPENDIX III

*Myotis nesopolus* (N=1).—COLOMBIA: Guajira, Municipio de Albania, Cerrejón, Río Ranchería, Los Pozos, (11°09'35.01"N, 72°35'06.09"W) (ICN 19174 ♂).

*Myotis nigricans* (N=15).—COLOMBIA: Bolívar, Municipio Santa Catalina, Hacienda El Ceibal (10°37.4'N, 75°14.5'W) (ICN 16040 ♂, ICN 16041-42 ♀, ICN 16043-48 ♂). Córdoba, Municipio Ayapel, El Caserio Playa Blanca, Finca El Quebrache (08°11'11"N, 74°59'21"W) (ICN 17326 ♀, ICN 17327 ♂, ICN 17328-30 ♀). Córdoba, Municipio Lorica, Finca Pantano Bonito (09°14'14.20"N, 75°48'13"W) (ICN 17331 ♀). Córdoba, Pueblo Nuevo, (08°30'10.00"N, 75°29'53.83"W) (ICN 17337, sex undetermined).